

**Weather and Water Cycle Standards**

**S4E3. Students will differentiate between the states of water and how they relate to the water cycle and weather.**

- Demonstrate how water changes states from solid (ice) to liquid (water) to gas (water vapor/steam) and changes from gas to liquid to solid.
- Identify the temperatures at which water becomes a solid and at which water becomes a gas.
- Investigate how clouds are formed.
- Explain the water cycle (evaporation, condensation, and precipitation).
- Investigate different forms of precipitation and sky conditions. (rain, snow, sleet, hail, clouds, and fog).

**S4E4. Students will analyze weather charts/maps and collect weather data to predict weather events and infer patterns and seasonal changes.**

- Identify weather instruments and explain how each is used in gathering weather data and making forecasts (thermometer, rain gauge, barometer, wind vane, anemometer).
- Using a weather map, identify the fronts, temperature, and precipitation and use the information to interpret the weather conditions.
- Use observations and records of weather conditions to predict weather patterns throughout the year.
- Differentiate between weather and climate.

**What you should know:**

- The water cycle involves liquid being evaporated; water vapor condensing to form rain or snow in clouds which falls to the earth (Know the types of cloud by pictures. How can you predict the weather from a cloud?)
- Water can evaporate from plants, animals, and puddles in the ground; in addition to bodies of water.
- Bubbles that form and rise when water is boiling consists of steam (or water vapor).
- The gas escaping from boiling water is water vapor. When this vapor condenses in the air, it is visible as tiny water droplets.
- Water left in an open container evaporates, changing from liquid to gas.

**WHAT YOU SHOULD UNDERSTAND ABOUT THE WATER CYCLE AND WEATHER?**

The sun is the main source of energy that begins the water cycle.

- Some events in nature have a repeating pattern. The weather changes from day to day, but some things such as temperature and rain (or snow) tend to be high, low, or medium in the same months every year
- Water can be liquid or solid and can go back and forth from one form to the other. If water is turned into ice and then allowed to melt, the amount of water is the same as it was before freezing.
- Water left in an open container disappears, but water in a closed container does not disappear.
- Weather is a daily occurrence; climate occurs over an extended period of time.
- Different temperatures affect water, changing the states.
- Condensation is water vapor in the air, which cools sufficiently to become liquid. This usually happens when the water vapor comes in contact with a cool surface.
- Raindrops begin to fall when water drops in the cloud are too heavy to remain airborne- (a part of the cloud).
- The shape of a raindrop is based on size. Small raindrops are spherical, medium sized are a bit flattened but still basically spherical, and larger raindrops get distorted until they break into smaller drops.
- A raindrop's shape is dependent upon the surface tension of water and the air pressure pushing up on the drop as it falls.

**DEFINITIONS FOR WATER CYCLE AND WEATHER**

- ☐ Water cycle – the constant movement of water from the surface of Earth to the air and back again
- ☐ Water vapor – the gas form of water
- ☐ Evaporation – the process by which a liquid changes into a gas
- ☐ Condensation – the process by which a gas changes into a liquid
- ☐ Precipitation – water that falls from the clouds to the Earth’s surface (Rain, Snow, Sleet, Hail)
- ☐ Thermometer – an instrument used to determine how hot or cold the weather is
- ☐ Rain gauge – an instrument that collects and measures rain
- ☐ Barometer – an instrument for measuring air pressure
- ☐ Wind vane – an instrument that gives the direction the wind is blowing
- ☐ Anemometer – an instrument for measuring wind speed
- ☐ Front – the border where two air masses meet
- ☐ Meteorology – the study of weather
- ☐ Meteorologist – a scientist who studies weather
- ☐ Air mass – a large body of air that has similar temperature and humidity throughout
- ☐ Weather – the condition of the atmosphere at a certain place in time
- ☐ Climate – a pattern of weather an area experiences ***over a long period of time***
- ☐ Temperature – how hot or cold the weather is at any given time
  - Freezing- Water turns from a liquid to a solid
- ☐ ***High pressure – the air is more dense, cooler, and has less humidity (less chance of rain); associated with clear skies and calm weather***
- ☐ ***Low pressure – the air is less dense, warmer, and has more humidity (more chance of rain); associated with high winds, precipitation, and bad weather***
- ☐ Cold front – when a cold air mass replaces a warm air mass at the surface
- ☐ Warm front – when a warm air mass replaces a cool air mass at the surface
- ☐ Humidity – water vapor in the air
- ☐ Clouds – water vapor that clumps together in the air
- ☐ Cumulus clouds – puffy cotton-looking clouds with a flat base (these clouds grow upward)
- ☐ Cumulonimbus clouds – dark clouds that carry precipitation (storm clouds, rain, sleet, snow, etc.)
- ☐ Cirrus clouds – thin, wispy clouds blown in by high winds (high clouds)
- ☐ Stratus clouds – uniform gray clouds that cover the sky; lowest clouds in the sky
- ☐ Fog – a stratus cloud that has condensed / touched the earth; formed in the same way as a cloud
- ☐ Front – the border where two air masses meet
- ☐ Weather map – a map that uses symbols to show weather; gives information about what the weather is like in an area
- ☐ Weather symbols – symbols on the map that show you what type of weather is occurring in an area; a red line with half circles indicates a warm front, a blue line with triangles indicates a cold front, a black dot contains a “White H” indicates a high pressure system, a black dot that contains a “White L” indicates a low pressure system

**Water freezes and ice melts at 32° F or 0° C.**





**Water boils at 212° F or 100° C.**

**From the textbook:**

You have begun to see that **weather** is the condition of the atmosphere at a particular time and place. Much of what you may call weather is actually part of the water cycle. Some areas of the atmosphere have more water vapor than other areas. The amount of water vapor in the air is called **humidity**. A large amount of water vapor in the air is high humidity. A small amount of water vapor in the air is low humidity

Humidity depends partly on the air's temperature. Warm air can have more water vapor in it than cold air can. Suppose you're on an island near the equator. The air over the island is warm. The humidity is high because the air contains a lot of water that has evaporated from the ocean.

Clouds form in air that is relatively high in humidity. As warm air is forced up, it cools. Some of the water vapor begins to condense on dust and other particles in the air. **As more and more water condenses, a cloud forms. A cloud is basically dust and condensed water. (Water droplets bond or stick together.)** (p.122)

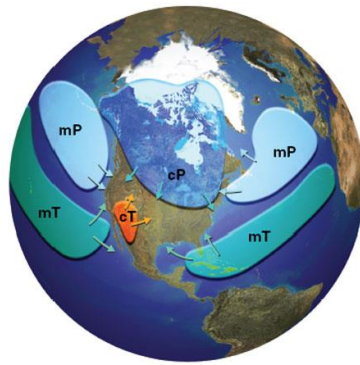
Weather Instrument	Measures
 <p data-bbox="415 1115 581 1140"><b>Thermometer</b></p>	<p data-bbox="889 1003 1487 1079">A thermometer measures air temperature. If the air cools down during the day or warms up in the evening, this change is a sign that rain may fall soon.</p>
 <p data-bbox="415 1381 542 1407"><b>Barometer</b></p>	<p data-bbox="889 1247 1484 1323">A <b>barometer</b> measures the air pressure, which is also called <i>barometric pressure</i>. A change in the air pressure often means the weather is about to change.</p>
 <p data-bbox="415 1591 565 1617"><b>Anemometer</b></p>	<p data-bbox="889 1486 1487 1562">An <b>anemometer</b> measures wind speed. Like a change in air pressure, a change in wind speed may mean that the weather is about to change.</p>
 <p data-bbox="415 1780 553 1806"><b>Hygrometer</b></p>	<p data-bbox="889 1696 1435 1751">A <b>hygrometer</b> measures humidity. An increase in humidity often means it's about to rain.</p>

In the past, people relied on simple observations to help them forecast the weather. Sayings such as "Red sky at night, sailors' delight" helped people remember what their observations might predict about the weather.

In contrast, **a falling barometer reading often indicates the presence of warmer, more humid air and a greater chance of rain.** Just as you did in the Investigate, meteorologists use **rain gauges to measure rainfall amounts.**

Wind is another weather factor that should be considered. Several instruments can be used to measure wind. **Anemometers measure wind speed.** Both **windsocks and wind vanes measure wind direction.** Information about wind speed and direction is important because wind often brings changes in the weather. Knowing which direction the wind is blowing from helps forecast the weather. For example, if it's winter and a wind starts blowing from the south, you can predict that the weather will soon be warmer.

**Different cloud types are also associated with different types of weather. For example, cirrus clouds and small cumulus clouds mean fair weather is ahead. Large, gray cumulus clouds mean rain is probably on the way.** (Page 133)



## Air Masses

The sun heats Earth's atmosphere unevenly. The uneven heating causes the air to move. Air doesn't move around Earth randomly. Instead, air moves in regular, large air masses. An **air mass** is a large body of air that has the same temperature and humidity throughout.

Air masses can be warm or cold. They can also be humid or dry. What determines the characteristics of an air mass? An air mass takes on the characteristics of the region over which it forms. For example, an air mass that forms over the Pacific Ocean near the equator will be humid and warm. An air mass that forms over northern Canada will be dry and cold.

Look at the map above. Four kinds of air masses affect weather in the United States. Continental polar air masses (cP) bring cool, dry weather. Continental tropical air masses (cT) bring hot, dry weather. Maritime polar air masses (mP) bring cold, humid weather. Finally, maritime tropical air masses (mT) bring warm, humid weather.

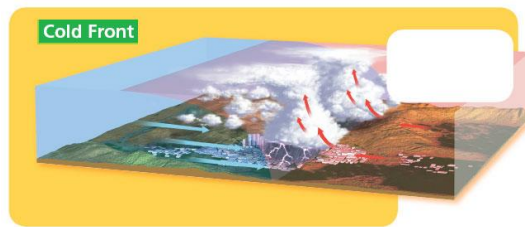
When the weather changes in an area, the air mass over the area is changing. That is, the current air mass is being replaced by a different air mass. Changing air masses produce winds. Air masses generally move from west to east across the United States. (page 134)

## Fronts

The border where two air masses meet is called a **front**. Most weather changes occur along fronts. For example, if a cold, dense air mass pushes into a warm, light air mass, the warm air is forced up. As that air moves up, it cools. Water vapor in the air condenses, and clouds form.

There are two main kinds of fronts, cold fronts and warm fronts. A cold front forms where a cold air mass moves under a warm air mass. The warm air mass is less dense, so it is pushed up and cooled. **When a warm, moist air mass is suddenly cooled, much of the water vapor in the air mass condenses rapidly. This fast cooling and condensation causes heavy rain, thunderstorms, or snow.** Cold fronts usually move quickly, so the storms they bring do not last long. **(Warm, moist air combines with cool air will likely create a thunderstorm.)**

A warm front forms where a warm air mass moves over a cold air mass. As the warm air slowly slides up and over the cold air, stratus clouds form ahead of the front. They produce rain or snow that can last for hours. (page 135)



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**After a warm front passes through an area, the weather is warmer and more humid.  
After a cold front passes through an area, the weather is cooler and drier.**

## Weather Maps

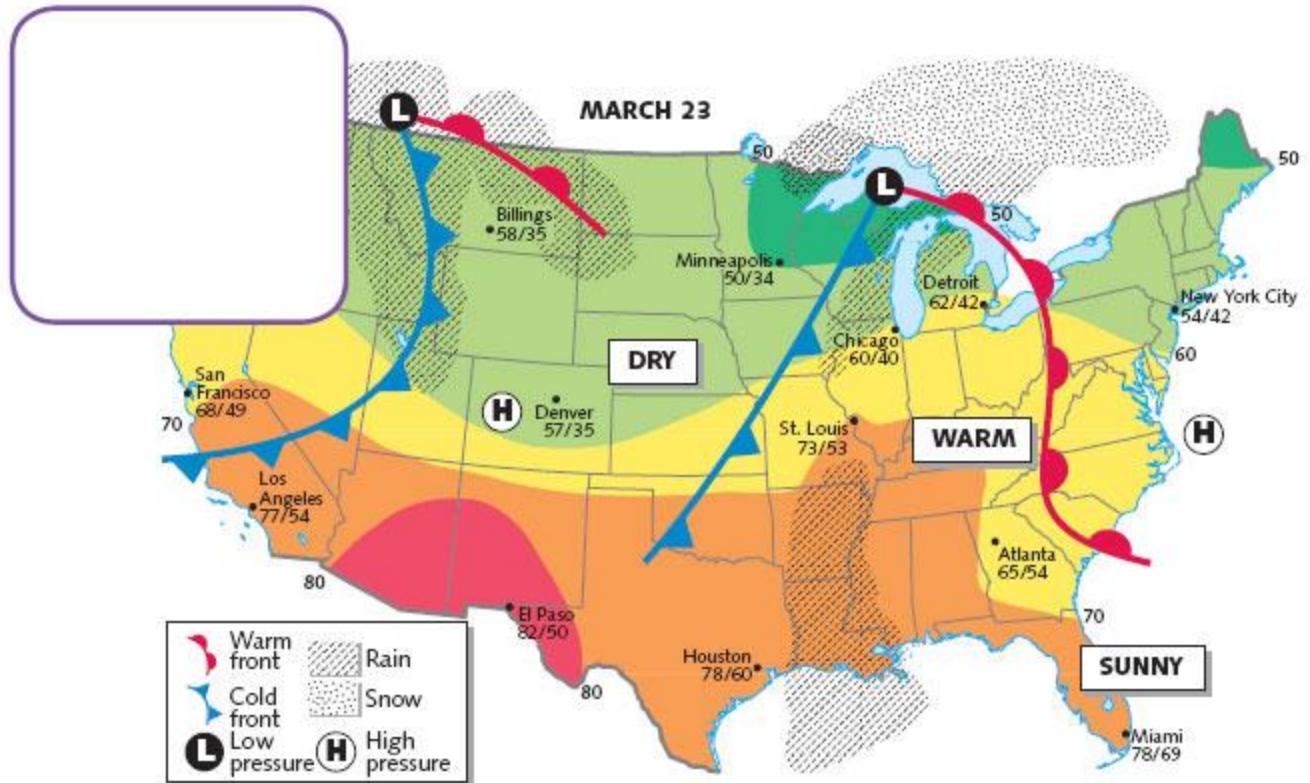
Have you ever used a street map to find someone's house? Another kind of map you can use is a weather map. A weather map gives information about what the weather is like in an area.

Weather maps use symbols to show the weather. A sun symbol means it's sunny in the area. The symbol of a cloud with rain means it's raining in the area. Fronts are also shown on weather maps. The symbol for a warm front is a red line with half circles on the side of the direction the front is moving. A blue line with triangles shows a cold front.

Another kind of information given on a weather map is temperature. Separate temperatures may be written on the map, or temperatures may be shown by colors. The map's key explains what each of the symbols means.

Other information you may see on a weather map includes the high and low temperatures for that day, the wind speed and direction, and the air pressure. High- and low-pressure systems may be indicated on a weather map as well. A high-pressure system is symbolized by an *H*. High-pressure systems form where an area of cool, dense air is surrounded on all sides by lower-pressure air. A low-pressure system is symbolized on a weather map by an *L*. Low-pressure systems form where an area of warm, light air is surrounded by higher-pressure air.

Using your knowledge that weather in the United States usually moves from west to east, predict the weather that Atlanta will have in the next day or so.



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Data taken from: [https://www-k6.thinkcentral.com/content/hsp/science/hspscience/ga/gr4/se\\_9780153734168\\_/flashNavhigh.html?page=toc](https://www-k6.thinkcentral.com/content/hsp/science/hspscience/ga/gr4/se_9780153734168_/flashNavhigh.html?page=toc)

Air pressure decreases → better chance of rain / thunderstorms

Air pressure increases → better chance a sunny / warm conditions

Higher temperature → warm front

High air pressure → clear skies